UNITED STATES
AIR FORCE ACADEMY

Department of Biology

BIOLOGY MAJORS' HANDBOOK

2007-2008 Academic Year

BIOLOGY – "the science of life, of living matter in all its forms and phenomena."
Random House Dictionary

"My dear fellow, life is infinitely stranger than anything which the mind of man could invent. We would not dare to conceive the things which are really mere commonplaces of existence."
Sir Arthur Conan Doyle

"We all live in secondhand suits and there are doubtless atoms in my chin which have served many another man, many a dog, many an eel, many a dinosaur. Nor does the vanity of our bodies, even in this present life, consist in retaining the same particles. My form remains one, though the matter in it changes continually. I am, in that respect, like a curve in a waterfall."
C. S. Lewis

"The study of biology is, indeed, pertinent to many aspects of our day-to-day existence, but do not make this your main reason for the study of biology. Above all other considerations, study biology…for its own sake, because, like art and music and literature, it is an adventure for the mind and nourishment for the spirit."
Helena Curtis

BIOLOGY MAJORS' HANDBOOK

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AREAS OF INTEREST WITHIN THE BIOLOGY MAJOR

The field of Biology is extremely diverse. For that reason, the USAFA Department of Biology offers a wide range of academic courses and programs tailored to meet the needs and interests of all cadets pursuing a degree in Biology. Depending on your natural talents, experience, interests, and abilities, the following areas of interest within the field of Biology may be for you:

ENVIRONMENTAL AND ORGANISMAL BIOLOGY

This curriculum combines the general knowledge of Biology, the physical world (chemistry, meteorology, geology, geography, physics), the human element (politics, economics, and behavior), and problem-solving skills (engineering and mathematics) to understand man's role and impact on the planet Earth. Cadets interested in these general areas of Biology are able to design a personal program of study more suited to their needs and desires.

Suggested Courses: Vertebrate Zoology (Bio 430), Microbiology (Bio 431), Principles of Evolution (Bio 459), Applied Ecology (Bio 481), Chemistry of the Environment (Chem 381), Biochemistry (Chem 434), Fundamental Hydraulics (Civ Engr 361), Introduction to Environmental Engineering (Civ Engr 362), and various Geospatial Sciences courses.

AF-Relevant Issues and Career Fields: Bioenvironmental Engineering (see below), Bird-Aircraft Strike Hazard (BASH) Program, Bioremediation, Natural Resources.

Bioenvironmental Engineering

A 2002 policy change now allows USAFA graduates from the laboratory-science majors (i.e., Biology, Chemistry, Physics) to compete for Bioenvironmental Engineering (BEE) slots. Bioenvironmental engineers apply engineering and scientific knowledge and techniques to: identify and manage risks for health protection; develop procedures, techniques, and equipment; conduct and supervise engineering services; and participate in medical-facility programs. Suggested courses: Microbiology (Bio 431), Introduction to Environmental Engineering (Civ Engr 362), Ground and Surface Water Hydrology and Containment Transport (Civ Engr 368), Introduction to Air Pollution (Civ Engr 369), Wastewater Treatment Plant Design (Civ Engr 463), Water Treatment Principles and Design (Civ Engr 467), Organic Chemistry Laboratory (Chem 243), Biochemistry (Chem 434), and Molecular Biology Methods (Bio 464).

CELLULAR AND MOLECULAR BIOLOGY

This curriculum combines the study of biochemical and cellular-level processes to understand the rapidly growing fields of genetic engineering, immunology, disease defense, hormonal control, aging, and cancer.

Suggested Courses: Microbiology (Bio 431), Molecular Biology Methods (Bio 464), Organic Chemistry (Chem 333/334), and Biochemistry (Chem 434).

AF-Relevant Issues and Career Fields: Research scientist (61S career field), pathology, immunology, genetic engineering, infectious-disease control, biological-weapons detection and control.

HUMAN BIOLOGY

This curriculum comprises the study of human anatomy and physiology. There are various avenues of study within this sub-discipline:

Human Factors and Performance

The plan of elective courses can be tailored to student interests in the physical, physiological, mechanical, and psychological factors related to the man-machine interface (human factors) or to

optimizing and teaching neuromuscular skills (performance, athletics). Suggested courses: Biomechanics (Bio 320), Aerospace Physiology (Bio 345), Anatomy and Physiology: Sensory and Motor Integration (Bio 410), Aviation Psychology (Beh Sci 371), Introduction to Human Factors (Beh Sci 373), Biopsychology (Beh Sci 355), Engineering Psychology (Beh Sci 471).

Aerospace Physiology

An Air Force aerospace physiologist manages aerospace-physiological training and hyperbaric-therapy units, conducts research, and is an expert on the human aspects of manned high-altitude/high-speed flight (including space flight). Completion of this recommended program within the Aerospace Physiology track with a cumulative GPA ≥3.00 will make you competitive for direct entry into the Biomedical Sciences Corps (BSC) as an aerospace physiologist. If you fail to meet these standards, you may still apply for entry into this career field, but you may not be fully competitive. **[**NOTE: The number of cadets who can directly enter this career field is very limited.**]** Suggested courses: Aerospace Physiology (Bio 345), Human Nutrition (Bio 370), Anatomy and Physiology: Sensory and Motor Integration (Bio 410), Anatomy and Physiology: Visceral Systems Integration (Bio 440), Exercise Physiology (PE 440).

Physical Therapy

A direct form of professional patient care that can be applied to patients referred from most disciplines of medicine. These include, but are not limited to: family practice, internal medicine, surgery, rheumatology, obstetrics, cardiovascular surgery, flight medicine, dental service, neurology, neurosurgery, orthopedics, podiatry, and pediatrics. Completion of this recommended program within the Physical Therapy track with a cumulative GPA ≥3.1, and a MPA "in good standing" will allow you to compete for direct entry into the Biomedical Science Corps. If accepted, you will enter the 24-month Physical Therapy Doctoral Program at the U.S. Army-Baylor Medical School. Upon completion of this program, you will incur an additional 3-year, 3-month commitment. Required courses: Anatomy and Physiology: Sensory and Motor Integration (Bio 410), Anatomy and Physiology: Visceral Systems Integration (Bio 440), and Lifespan Development (Beh Sci 320). Suggested courses: Biomechanics (Bio 320), Exercise Physiology (PE 440).

ADVANCED DEGREES

The opportunity exists for cadets to pursue future graduate or professional studies in any area of the biological sciences (including medical, dental, and nursing schools; see the following section). For cadets wishing to attend graduate school, the minimum AFIT requirements are a cumulative GPA of 2.50 in an undergraduate program and a GRE score >1000. However, to gain admission into many civilian graduate programs, a cumulative GPA ≥3.00 and a GRE ≥1200 may be required to be competitive.

The very competitive Graduate School Program (GSP) allows new graduates to directly enter a 12-month Masters-degree program. Biology majors who apply for this program must agree to return to the USAFA as a DFB faculty member after acquiring appropriate Air Force experience. During the Fall semester, the AIC will contact those firsties meeting the minimum standards (cum GPA $\geq$3.0 and an MPA $\geq$2.5 for DF; DFB may elect to set higher minima), and query their interest in pursuing a GSP slot. Interested and qualified firsties will then prepare an application package (via CAMIS) in collaboration with the AIC.

CADETS CONSIDERING THE HEALTH-RELATED PROFESSIONS

The USAFA may send ≤4% of each graduating class (approximately 38 cadets) to the health professions-related fields, including medical, dental, and nursing schools, as well as the BSC and MSC. In 2006, the SECAF and Surgeon General authorized the following accessions ceilings for all of the Health Professions:

Corps	USAFA Accession Ceiling
Medical Corps (MC)	18
Dental Corps (DC)	2
Nurse Corps (NC)	3
Biomedical Sciences Corps (BSC)	5
Medical Service Corps (MSC)	4
All Corps flexibility	6
Total	**38**

Cadets pursuing entry into the Biomedical Sciences Corps (BSC) or the Medical Service Corps (MSC) will be considered by the Health Professions Advisory Committee (HPAC) working with members of the BSC and MSC.

The approximate accession numbers, available scholarship programs, and additional military-service commitments for USAFA students attending medical, dental, and nursing schools are as follows:

Medical School
The USAFA may send approximately 18 cadets from each graduating class to medical school. The Air Force will use the Health Professions Scholarship Program (HPSP) to fund schooling unless a candidate attends the DoD Uniformed Services University of the Health Sciences (USUHS). If a medical student is supported by the HPSP, she/he incurs 4 additional years of commitment to the Air Force. If a student attends USUHS, she/he incurs 7 more years of obligation. Each individual should fully understand these obligations before committing.

Dental School
Approximately 2 cadets from each graduating class may go directly to dental school. The Air Force will use the HPSP to support schooling. Each individual supported by the HPSP for dental school incurs 4 additional years of commitment to the Air Force. Contact the Health Professions Advisors for additional information on dental-school opportunities and requirements.

Advanced Practice Nursing
The USAFA may send approximately 3 cadets from each graduating class to the Clinical Nurse Management/Clinical Nurse Leader for a Master of Science degree in Nursing at Vanderbilt University School of Nursing. An individual supported by the HPSP for advanced-practice nursing incurs 2 additional years of commitment to the Air Force. Contact the Health Professions Advisors for additional information on coursework and other requirements for nursing school.

As described in the preceding paragraphs, the USAFA has scholarships for cadets who want to attend medical, dental, or nursing school immediately after graduation. Briefly, here is the process by which the USAFA selects cadets as candidates for these professional and graduate schools. First, by the end of the two-degree year, a cadet must meet the minimum academic, professional-exam, and military requirements summarized in the table on the following page. *Note: MPA requirements subject to change*.

FIELD	GPA	MPA	Exam (min)	Required Courses beyond USAFA Core
Medicine	3.0 (if MCAT > 9.0) 3.25 (no min MCAT)	≥2.5	MCAT	1 year of organic chemistry plus lab (Chem 333, Chem 334, *and* Chem 343), 1 semester of biology with lab (e.g., Bio 330, Bio 363, Bio 410, Bio 440)
Dentistry	≥3.0	≥2.5	DAT (17/30)	1 year of organic chemistry plus lab, 1 semester of biology with lab
Advanced Practice Nursing	≥3.0	≥2.5	GRE (1100)	Anatomy & Physiology (Bio 410 and Bio 440), Microbiology (Bio 431), Human Nutrition (Bio 370), Lifespan Development (Beh Sci 320)

Second, a cadet must be approved by the Health Professions Advisory Committee (HPAC), the Graduate Scholarship Committee (GSC), the Dean, the Commandant, and the Superintendent. The most intense scrutiny is conducted by the HPAC, which will review the records, interview each cadet, and submit its recommendations to the Superintendent via the GSC. This selection occurs in the Spring of the two-degree year; however, each candidate will be monitored through the firstie year.

This information should identify minimum requirements necessary for various post-graduate degree programs. Please direct any questions to the Health Professions Advisors in the Department of Biology, at 333-2720.

THE BIOLOGY MAJOR

The Biology Major is recommended for the student who possesses both aptitude and interest in any area of the biological sciences. This major is designed to promote the development of your natural scientific talents through a carefully planned program of academic instruction, practical laboratory experience, and individual research projects. Specialized programs within the Biology Major provide for a multidisciplinary approach to the study of environmental sciences and the human-performance aspects of high-altitude/high-speed flight. You can pursue a flexible program simply to meet your own interest or to satisfy prerequisites for entry into medical school, dental school, nursing school, graduate school, or various biologically oriented career fields within the U.S. Air Force.

BASIC REQUIREMENTS: **147** semester hours

A. **96** semester hours of Dean's academic core courses (see *2007-2008 Curriculum Handbook*), including 6 hours of foreign language. The core statistics option for Biology majors (class of 2009 and beyond) must be **Math 356**.

B. **5** semester hours of Director of Athletics core courses.

C. **1** semester hour of First Year Experience.

D. **3** semester hours of Academy Option (any 3-hour non-core course offered by DF).

E. **24** semester hours of fundamental majors' courses to view the breadth, key concepts, and integration of Biology. These specific courses are required for all Biology majors:

1. Biology 330: Zoology
2. Biology 331: Botany
3. Biology 332: Microbial Diversity
4. Biology 360: Cell and Molecular Biology
5. Biology 363: Genetics
6. Biology 380: Principles of Ecology
7. Biology 480: Biology Capstone Seminar
8. Human Physiology Option[a]

[a]Accepted courses: Biology 345 (Aerospace Physiology), Biology 410 (Anatomy and Physiology: Sensory and Motor Integration), Biology 440 (Anatomy and Physiology: Visceral Systems Integration).

D. **18** additional semester hours:

1. Biology Option #1[b]
2. Biology Option #2
3. Biology Option #3
4. Chemistry Option (Chem 230 or 333)
5. Scientific Breadth Option #1[c,d]
6. Scientific Breadth Option #2

[b]The Biology Option can be filled with any 300- or 400-level Biology course; a maximum of 1 organic chemistry (Chemistry 333 or 334) or biochemistry course (Chemistry 434) may fulfill a Biology Option.

[c]The Scientific Breadth Option may include any 200-, 300-, and 400-level non-core courses offered by the Departments of Biology, Chemistry, Physics, Computer Science, and/or Mathematical Sciences. Additionally, the following courses from other academic divisions are approved, as they fulfill the intent of the Scientific Breadth Option by enhancing the science of Biology:

Beh Sci 320	Lifespan Development
Beh Sci 355	Biopsychology

Beh Sci 373	Introduction to Human Factors
Civ Engr 362	Introduction to Environmental Engineering
Civ Engr 368	Ground and Surface Water Hydrology and Contaminant Transport
Civ Engr 369	Introduction to Air Pollution
Civ Engr 463	Wastewater Treatment Plant Design
Civ Engr 467	Water Treatment Principles and Design
Geo 350	Human Geography
Geo 351	Introduction to Physical Geography
Geo 353	Geomorphology
Geo 360	Environmental Geography
Geo 382	Remote Sensing and Imagery Analysis
History 482	History of Science and Technology
Law 371	Environmental Law and Policy
Philos 330	Introduction to the Philosophy of Science
Philos 410	Medical Ethics

NOTE: Other course offerings may be considered with DFB Department Head approval (i.e., USAFA Form 69 waiver, initiated by academic advisor).

[d]200-, 300-, and 400-level foreign-language courses taken in fulfillment of a foreign-language minor may be substituted for one or both Scientific Breadth Option courses. See the next section for additional information on this opportunity.

BIOLOGY WITH A DIVISIONAL MAJOR, A DISCIPLINARY MAJOR, OR A MINOR

The Biology Major is one of the most flexible majors at the USAFA. The biology and scientific breadth options provided by the Biology Major can be filled by any course unit offered within these categories approved by your academic advisor. You can graduate with a biology major and a divisional major, another disciplinary major, or a minor.

Biology Major with Divisional Major
The divisional major cannot be Basic Sciences; it must be from another academic division.

Biology Major with Other Disciplinary Major
The secondary disciplinary major can include any discipline, but you must complete ≥4 non-core courses in residence beyond the primary major's requirements *and* must meet all requirements of the secondary major.

Biology Major with Minor
A minor can be obtained in foreign language or philosophy. For a foreign-language minor, you must take 4 200-level or above courses in the same language and earn a grade ≥C in each. A philosophy minor requires 4 philosophy courses beyond the USAFA core requirement (i.e., in addition to Philos 310).

Substitution of Foreign-Language Courses for the Scientific Breadth Option
Biology majors who will complete a minor in a foreign language may substitute 200-, 300-, and 400-level foreign-language courses for one or both of their Scientific Breadth Option courses with the approval of the DFB Department Head. Cadets must submit a USAFA Form 69 (Academic Waiver Request) through their Academic Advisor. *If the cadet fails to make satisfactory progress toward completing the minor, permission to substitute foreign-language courses for the Scientific Breadth Option may be withdrawn* (e.g., if a cadet receives permission to substitute a foreign-language course for their first Scientific Breadth Option, and then receives a D in that course, permission to substitute a foreign-language course for the second Scientific Breadth Option will not be granted, or will be withdrawn if already granted).

BIOLOGY COURSES

Biology 210: Foundations of Biology with Laboratory 3(2)

This course establishes a foundation for further study in the biological sciences. It is required for Biology majors, and recommended for those pursuing advanced courses in biology (e.g., cadets pursuing careers in the Medical, Dental, Nursing, and Biomedical Sciences Corps). Biology 210 serves as a core substitute for Biology 315. The course presents the concepts essential for understanding modern biology. Course content includes: cell biology, metabolism, genetics, biotechnology, and evolution. Discussions address application of the scientific method, ethical issues of modern biology, and the influence of biological factors on Air Force planning and operations. Laboratories reinforce concepts, promote critical thinking, and introduce essential laboratory skills. Final exam. Prereq: Chemistry 110 or Chemistry 200. Semester hrs: 3. Fall or Spring.

Biology 315: Introductory Biology with Laboratory 3(2)

An overview of biological systems, covering concepts essential to understanding key issues in biology today. Cadets learn how biological systems are organized and operate throughout the biological hierarchy. Decision-making based on an understanding of biological systems is applied to Air Force operations, and to the health and fitness of the Air Force Officer. Concepts are reinforced through critical-thinking exercises, hands-on activities, and laboratory experiences. Final exam. Prereq: Chemistry 110 or Chemistry 200. Semester hours: 3. Fall or Spring.

Biology 320: Biomechanics 3(1)

A study of the physical, anatomical, mechanical, and physiological basis for motion focused on the human. Joint and muscle physiology will be explored as a basis for functional activities. Physics and mechanical engineering concepts will be applied to describe, investigate, and compare the ways we initiate and control movement. Students will also learn the effects musculoskeletal injury may have on normal motion. Final exam. Prereq: Biology 210 and Engr Mech 220. Semester hours: 3. **Spring only.**

Biology 330: Zoology 3(2)

An integrated study of the principles of vertebrate and invertebrate zoology presented within a phylogenetic context. Examines the behavior, ecology, morphology, physiology, reproductive biology, classification, and evolutionary relationships of animals. Functional aspects of respiration, circulation, osmoregulation, excretion, metabolism, and thermoregulation are highlighted through comparisons within and among animal groups. Through laboratory exercises, students will learn and recognize structural, physiological, and evolutionary features of selected animals. Final exam. Prereq: Biology 210. Semester hours: 3. Fall or Spring.

Biology 331: Botany 3(2)

An integrated study of the biology of plants is presented from the molecular to community levels of organization. Course content is organized into five units of study: the plant system, plant anatomy and morphology, plant physiological ecology, plant reproductive biology, and plant evolution and classification.

Although the course focuses primarily on seed plants, other organisms such as fungi, algae, and lichens are explored. The study of plants is important because of their relevance to nutrition, drugs, celebration, and objects from daily life such as paper products, clothing, furniture, and flowers. A botanical perspective enriches an understanding of the natural world. Laboratory and fieldwork are required. Final exam. Prereq: Biology 210. Semester hours: 3. Fall or Spring.

Biology 332: Microbial Diversity 3(1)

Microscopic organisms are intimately involved in our daily lives where they produce many familiar foods and medicines, impact health, and play important roles in natural and engineered systems. This course will survey microbial groups that include algae, bacteria, fungi, protozoa, viruses, viroids, prions, and selected invertebrates. Each group will be considered in terms of structure, classification, biochemistry, ecology, and economic and medical significance. Relevance to the Air Force mission, such as deployment health issues and biowarfare defense, is reinforced throughout the course. Includes integrated labs and demonstrations. Final exam or final project. Prereq: Biology 210. Semester hours: 3. Fall or Spring.

Biology 345: Aerospace Physiology 3(1)

This course provides in-depth knowledge as to how human performance relates to the warrior and aircrew member. Specifically, it includes a survey of the physiological stresses associated with the aerospace environment. Topics include: effects of pressure changes with altitude, hyperbaric environments, respiratory and circulatory physiology, hypoxia and hyperventilation, pressurization and aircraft decompression, effects of "G" forces, self-imposed stresses, thermal stresses, human factors, crash dynamics and escape systems, sensory physiology, spatial disorientation, and space physiology. This course is suitable for cadets majoring in any academic discipline, including the divisional majors or other programs. Optional field trip. Final exam. Prereq: Biology 315. Semester hours: 3. **Fall only.**

Biology 360: Cell and Molecular Biology 3(1)

Comprehensive examination of the cell, the fundamental unit of life. Emphasis on eukaryotic cells, cellular organization and processes, and how cell structure and activity ultimately determine structures and functions at the organismal level. Lesson topics include biomolecules, organelles, membrane structure and transport, cellular respiration, photosynthesis, intercellular connections and communication, cell division, fertilization, and development. Fundamental cellular concepts will be illustrated and reinforced through discussions of gamete formation, specialized cells (e.g., muscle and nerve cells), eukaryotic-cell evolution, immunology, natural and man-made drugs, and toxins (e.g., caffeine, cocaine, spider venoms, nerve gas), and various human pathologies (e.g., cancer, AIDS, multiple sclerosis, cystic fibrosis). Final exam. Prereq: Biology 210, and Chemistry 230 or 333, or concurrent enrollment recommended. Semester hours: 3. Fall or Spring.

Biology 363: Genetics 3(2)

A comprehensive study of the inheritance patterns of individuals and populations, including the mechanisms by which these patterns are expressed and changed. Additional emphasis is on current technologies, including genetic engineering, their role in exploring the nature of life, and the ethical burden this has placed on society. Laboratory work stresses an understanding of classical and molecular aspects of genetics. Optional field trip. Final exam. Prereq: Biology 210, Chemistry 230 or 333, or concurrent enrollment. Semester hours: 3. Fall or Spring.

Biology 370: Human Nutrition 3(1)

Provide a comprehensive, thoroughly updated account of nutrition principles and their application. This course furnishes students with accurate nutrition information and teaches them how to use a critical-

thinking approach in making important daily decisions about their own diet. Course material will focus on the fundamentals of nutrition such as defining the roles of carbohydrates, fats, proteins, vitamins, and minerals in metabolism; examining eating practices through individual dietary analysis, exploring the importance of nutrition in the prevention of disease; and discussing the interplay of diet options with various body systems for athletic performance, daily fitness, and overall health. Final exam. Prereq: Biology 315. Semester hours: 3. **Fall only.**

Biology 380: Principles of Ecology 3(1)

Fundamental interrelationships between organisms and their environments, emphasizing energy flow through ecosystems, biogeochemical cycling, population dynamics, and community interactions. Emphasis is placed on how human activities affect the quality of life and the natural world. Case studies include the impact of environmental concerns on regional and global Air Force operations. Final exam. Prereq: Biology 315. Semester hours: 3. Fall or Spring.

Biology 410: Anatomy and Physiology: Sensory and Motor Integration 3(2)

An introduction to human sensory and locomotory systems via experimentation and dissection of the human cadaver, with dissection emphasized. The course focuses on feedback mechanisms and the integration of organ systems for homeostasis and voluntary control. The following organ systems will be studied in detail: integumentary, skeletal, muscular, and nervous/sensory. Final exam or final project. Prereq: Biology 210. Semester hours: 3. **Fall only.**

Biology 430: Vertebrate Zoology 3(2)

A study of evolutionary origins, adaptations, characteristics, natural history, and classification of five major vertebrate groups: Fishes, Reptiles, Amphibians, Mammals, and Birds. Final exam or final project. Prereq: Biology 330. Semester hours: 3. **Fall only, odd-numbered years.**

Biology 431: Microbiology 3(2)

A study of classical microbiology to include: environmental, industrial, and medical applications. Laboratory studies to complement lectures. Systematics and classification of bacteria and viruses; the structure, function, and metabolic pathways of groups of bacteria. Microbial ecology of humans; disease processes and defense. Microbiology of waste disposal, waste treatment, environmental microbiology, and industrial microbiology, biowarfare, and bioterrorism. Final exam or final project. Prereq: Biology 332, Chemistry 230 or Chemistry 333. Semester hours: 3. **Spring only.**

Biology 440: Anatomy and Physiology: Visceral Systems Integration 3(2)

An introduction to systems physiology via experimentation and dissection of the human cadaver, with experimentation emphasized. The course focuses on feedback mechanism and the integration of organ systems for maintenance of homeostasis. The following topics will be studied: autonomic nervous control, digestion, cardiovascular regulation, respiration, endocrinology, nephrology, and reproduction. Final exam or final project. Prereq: Biology 210. Semester hours: 3. **Spring only.**

Biology 459: Principles of Evolution 3(1)

This course will examine the principles, patterns, mechanisms, and processes of biological evolution. The course format will comprise traditional lectures, student-led discussions, guest speakers, practical exercises, video programs, and selected readings. This course will draw on examples from botany, zoology, human anatomy, cell and molecular biology, ecology and genetics to provide a fuller understanding of Evolution in terms of evidence, processes, and outcomes. Through the study of

evolutionary biology, students will gain an appreciation of Evolution as a unifying theme in Biology, and will acquire a more complete understanding of the origins, diversity, interrelationships, geographical distributions, and adaptations of living organisms. Final exam. Prereq: Biology 363. Semester hours: 3. **Spring only, odd-numbered years.**

Biology 464: Molecular Biology Methods 3(2)

A practical study of the methods and techniques used in the modern molecular biology and genetic engineering laboratory. Instructor-assisted laboratory exercises with complementary lectures will focus on bacterial genetics, preparation and analysis of nucleic acids, recombinant DNA construction, bacterial transformation, analysis of cloned gene products, chromatographic separation of biomolecules, and polymerase chain reaction applications. Selected methods used in cancer, immunology, and animal development research will be included. Final exam or final project. Prereq: Biology 363, Chemistry 230 or 333. Semester hours: 3. **Fall only.**

Biology 480: Biology Capstone Seminar 3(1)

A survey of experimental biology through seminars, presentations of journal articles, and discussions. Emphasis is on student participation and exploring areas of current biological importance. Students will choose and analyze research papers, present their findings in seminars, discuss the ethical implications of research, and experience the scientific literature inherent in modern Biology. Final report. Prereq: C1C standing and Math 356. Semester hours: 3. Fall or Spring.

Biology 481: Applied Ecology 3(2)

Lecture and laboratories that address ecology and field biology. Lecture includes biotic and abiotic inputs and controls of various ecosystems. Laboratory exercises introduce survey techniques used in field studies. Classroom and laboratory work emphasizes environmental issues that are of special interest to Air Force personnel. Includes field studies conducted on the Academy grounds. Field trip. Final exam and/or final project. Prereq: Biology 380 or current enrollment with department permission. Semester hours: 3. **Fall only.**

Biology 486: Principles of Chemical, Biological, Radiological, and Nuclear (CBRN) Warfare Defense 3(1)

This course will cover the historical and contemporary use of CBRN weapons in state-sponsored warfare and terrorism. Mechanisms and biological effects of CBRN agents/weapons will be discussed. Topics covered will include various employment considerations for use of CBRN warfare agents and weapons, from state-sponsored to terrorist use, and will examine methods used for CBRN detection and identification. The current state of the CBRN defense community, including war-fighters, first responders, medical responders, and the intelligence community will also be evaluated. Final exam or final project. Prereq: Biology 315, Physics 215, Chemistry 200. Semester hours: 3. **Spring only.**

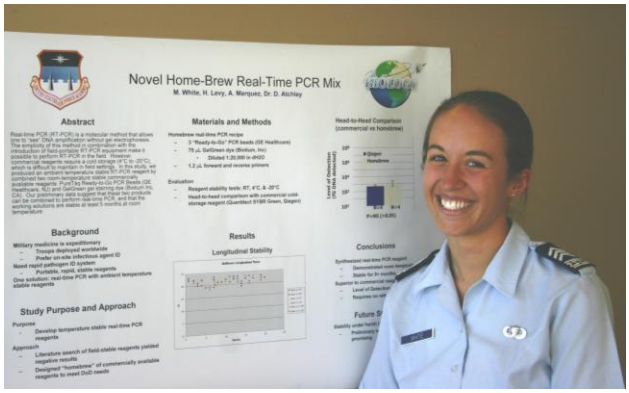
Biology 495: Special Topics 3(1)

Selected topics in the biological sciences. Final exam or final report. Prereq: Announced each semester. Semester hours and offering times determined by the department (not more than 3 semester hours). **[**See "Future Biology 495 Offering" on the following page.**]**

Biology 499: Independent Study 3(0)

Individual research or tutorial study in the biological sciences under the direction of a faculty member. Emphasis is on using pertinent biological literature and conducting laboratory research. Prereq: Math 356, cum GPA 3.0 and above (can be waived by department), and department permission. Semester hours: 3. Fall or Spring.

- Biology 499A. Independent Study. 2(0). Semester hours: 2. Fall or Spring.
- Biology 499B. Independent Study. 1.5(0). Semester hours: 1.5. Fall or Spring.
- Biology 499C. Independent Study. 1(0). Semester hours: 1. Fall or Spring.



FUTURE BIOLOGY 495 OFFERING

Biology 495: Bioethics in the Genomic Era 3(1)

In this course, we will explore the science behind and the social and ethical implications of many of the provocative headlines of 21st Century media, engaging questions such as: Should we and can we clone human beings? How should genomic information be used, and by whom? Who should have access to this information? What are the lines between gene therapy and cosmetic improvement? How does modern genomics redefine what we mean by "disease"? Should we design or select for "better" soldiers, doctors, musicians? To develop ethical and critical thinking skills, we will frame these questions from the perspectives of scientists, the military, and pharmaceutical companies, and explore them using case studies drawn from real-life situations, as well as from readings in the primary and popular literature. Oral presentation and final paper. Prereq: Biology 215. Semester hours: 3.
[Spring 2008]

AWARDS AND RECOGNITION FOR BIOLOGY MAJORS

The Outstanding First-Class Cadet in Biology Award

The Outstanding First-Class Cadet in Biology Award is presented each year to the graduating Biology major who has demonstrated academic excellence, a passion for, and a pursuit of knowledge in the field of Biology. The award is sponsored by the 384th Bomb Group, Inc. in memory of their members serving from 1942-1945.

The Outstanding Second-Class Cadet(s) in Biology Award

The Outstanding Second-Class Cadet(s) in Biology Award is presented each year to one or more two-degree Biology majors who have demonstrated academic excellence, a passion for, and a pursuit of knowledge in the field of Biology.

The Health Professions Award

The Health Professions Award is awarded annually to a graduating Biology major and recognizes excellence in preparation for a career in health care in general and the neurosciences in particular.

The Brig Gen Ronald Reed Research Award

The Brig Gen Ronald Reed Research Award will be presented each Spring to recognize and reward the Biology major who displays interest, initiative, and productivity in research throughout the major. This award will encompass all research-related activities throughout a cadet's undergraduate program of study. Only firsties are considered for this award. (class of 2007).

The Department of Biology Coin

Each Fall, the Department of Biology awards its firstie majors with a departmental coin. The coin recognizes the cadets' entry into the "community of biologists," particularly the USAFA community. The Department awards the coin to Biology Majors, Department of Biology faculty and staff, and a few honorary members. As with many military coins, the Biology Coin comes with the expectation that the USAFA biologist will carry the coin at all times. Trivial (but potentially costly...) repercussions may result when a USAFA biologist is discovered coinless.

The Department of Biology Coin was designed by Biology major Melanie Bates (Class of 2001), who is now a USAFA faculty member (Capt Melanie Presuto). The official seal of the USAFA appears on the reverse of this coin, while the obverse has a frog, the animal "mascot" of the Department of Biology. The first coins were produced in 2001, and first distributed to the Class of 2002 Biology majors.

RESEARCH OPPORTUNITIES FOR BIOLOGY MAJORS

CADET SUMMER RESEARCH PROGRAM

During the summer prior to your first-class year, you may be interested in participating in the Cadet Summer Research Program (CSRP). This competitive program is designed for cadets who are interested in research. These research slots are usually located at Air Force laboratories or national laboratories throughout the country. Cadets are normally assigned to the laboratories for a period of 5 weeks, working closely with a research scientist. In most cases, a cadet is assigned a small project to accomplish under the supervision of the sponsoring researcher. In the past, cadets have viewed this summer duty (normally, you will still have approximately 2 weeks of leave) as highly worthwhile and motivating. Many cadets have described the experience as one of the highlights of their academic careers. Most CSRP cadets give up their summer-leave slot to participate in the program.

To participate in the CSRP you must:

- have a $\geq$3.00 cumulative GPA
- have a $\geq$2.8 MPA
- have completed Operation Air Force
- not be on any type of probation

To maximize your chances for selection by the Department of Biology, you should excel in your Biology and Chemistry courses and have better than the minimum GPA.

Assignments of past CSRP participants include Wilford Hall Medical Center (Lackland AFB), Lawrence Livermore National Laboratories (Livermore, CA), Los Alamos National Laboratories (Los Alamos, NM), the NASA Life Sciences Program (Cape Kennedy, FL), the Air Force Institute for Operational Health (Brooks City Base), and the Force Protection Battlelab (Lackland AFB).

BIOLOGY 499 (INDEPENDENT STUDY)

If you are interested in participating in biological research during the regular academic semesters, consult with your academic advisor and register for one or more semesters of Biology 499. This individual research is conducted under the supervision and guidance of one or more faculty members who have expertise in your area of interest. The biological levels of focus can range from molecular to ecosystem, and your studies may be conducted in the laboratory, the field, or both. Biology 499 may be taken for 3, 2, 1.5, or 1 hour(s) of academic credit, and it can serve as a Biology, Scientific Breadth, or Academy Option on your degree plan.

Available Biology 499 projects are announced (via email and/or Majors' Meeting presentations) at the beginning of each academic year. In the Spring semester, cadets can also consult with faculty members to explore Biology 499 projects for the following Fall semester.

Most Biology 499 students present their research at the annual meetings (in Colorado, usually in April) of the Tri-Beta Biological Honor Society and/or the Colorado-Wyoming Academy of Sciences. Over the last few years, several Biology 499 projects have resulted in scientific publications or published abstracts with the cadets' names on the author line.

ACADEMIC COURSES WITH REQUIRED RESEARCH PROJECTS

Two Biology courses (offered in the Fall semester) include a research project as a course requirement. Most of these projects offer the potential for continuation as Biology 499 and the opportunity to present research results at local undergraduate research conferences.

- Biology 481 (Applied Ecology): Students work in pairs on a field-oriented research project.
- Biology 464 (Molecular Biology Methods): Students work in groups and employ molecular laboratory skills acquired in the course to approach an ill-defined research problem.

CAREERS IN THE BIOMEDICAL SCIENCES CORPS (BSC) AVAILABLE TO USAFA CADETS

There are four Biomedical Sciences Corps (BSC) specialties available to cadets:

- Aerospace Physiology
- Bioenvironmental Engineering (BEE)
- Health Physics
- Physical Therapy

If you are interested in joining the BSC after graduation, please contact Maj Tim Filzen (333-5144) for more information. The Department of Biology advises cadets interested in any of the four specialties. The following table contains basic information regarding each career field.

	Aerospace Physiology	**BEE**	**Health Physics**	**Physical Therapy**
Description of the career field	Teach physiological effects of flight. Expert on physiological problems associated with flight, conduct research. Supervise hypobaric chamber units.	Apply engineering and scientific knowledge in identifying and managing risks, including chemical, physical and biological stress factors, for health protection.	Ensure safe use of radioactive materials (RAM) and non-ionizing radiation. Survey and monitor RAM users Risk assessment, cleanup and restoration, waste disposal inspection and licensing with the NRC.	Evaluate, treat, and prevent orthopedic, cardiopulmonary, and neurologic disorders.
Requirements	GPA = 3.0	GPA = 3.0	GPA = 2.75 Physics major	GPA ≥3.1 GRE ≥1000 (450 verbal)
Required non-core courses, Science Major	No additional courses required.	No additional courses required	No additional courses required	Anatomy & Physiology I and II, Lifespan Development
Recommended courses	Aerospace Physiology, Introduction to Human Factors, Exercise Physiology	See page 4	Course in Biology	Biomechanics, Exercise Physiology, Medical Ethics
Should also have...	Observation time at a hypobaric chamber	Observation time with a BEE officer	Observation time with a Health Physics officer	REQUIRED: Minimum of 100 hours of volunteer time in a variety of PT clinics
When to apply	Apply for AP, BEE and HP early in the Fall of your firstie year. Applications are usually due to DPY by late September.			
How to apply	Submit an application package to Cadet Personnel (DPY). Briefly, the package includes a letter of intent with a personal essay, transcript, and recommendation letters. You will be interviewed by a senior officer in the career field for which you are applying. If you are applying for AP you will be required to pass a Class III flight physical.			
Relevant websites	BSC Home page: https://kx.afms.mil/ctb/groups/dotmil/documents/afms/knowledgejunction.hcst?functionalarea=BiomedicalSciencesCorps&checkinform=AFMS&doctype=home Health Physics Society: www.hps.org American Association of Physicists in Medicine: www.aapm.org Army-Baylor Physical Therapy Program: www.cs.amedd.army.mil/BaylorPT			

BIOLOGY ADVISORS

When you declare Biology as your major, one of the DFB Advisors-in-Charge (AICs) will assign you to one of the academic advisors (listed below) for your class year. You should obtain your advising folder from your AAOCA or previous academic advisor, and bring it to the DFB AIC when you declare/change to Biology. The AIC will briefly explain the academic requirements and flexibility of the Biology major; you then should consider the options and electives available, so that you play an active role in designing your academic program. Your DFB academic advisor will discuss your academic interests and career plans with you, and suggest appropriate electives and options for your course plan. The required Biology and Chemistry courses (see page 8) and the elective courses you select will then be added to your APS.

REFERENCE LETTERS

As you advance in your cadet career, you will likely need reference letters to support your applications for squadron/group-leadership positions, professional schools, graduate scholarships, and/or various career fields. Such letters are very important in the consideration of your application by selection committees and military leadership; accordingly, you should very carefully choose the individuals who will serve as your professional and personal references. Additionally, students should understand that receiving a reference letter is a privilege, not a right or entitlement. A potential reference may decline your request based on your mediocre performance in a class, their inability to write a strong letter for you, their support of other candidates, or constraints on their time.

Before requesting a reference

In the first paragraph of a reference letter, the writer typically defines their relationship with the applicant. Several sentences will be devoted to describing the duration, context (e.g., student in class, academic advisee, research mentee), and nature of the writer's association with the applicant. Obviously, a letter from a reference who has known the student very well for more than a year in several different contexts is going to have more positive impact than one written by an instructor who simply had the student in one course the previous semester. You should honestly consider what kind of reference letter an individual can and will write for you...will it be one that will strengthen your application?

Cadets should anticipate the need for reference letters, and, early in their cadet career, begin cultivating relationships with their instructors and advisors. A good plan is to get to know at least one instructor each year; visit his/her office on a regular basis for casual conversation and to discuss professional aspirations. This approach is perceived as good and appropriate strategy, not as "brown nosing" or "sucking up." Indeed, most instructors welcome such out-of-class interactions with cadets, and will embrace the opportunity to write a very informed reference letter as the need arises for the cadet.

Requesting the reference letter

- your request for a reference letter should be in the form of a polite communication (in person, or via email), well in advance of your application suspense (*minimum* of two weeks); DO NOT simply clip an explanatory note and resume outside an instructor's office!
- before explicitly asking for a letter, provide the potential reference with appropriate general information: what you are applying for, the suspense date for the reference letter; then ask
- once the reference has agreed to support your application with a letter, you should provide detailed pertinent information and other materials; do not compel the reference to incrementally extract information from you or to download forms that require your signature!
  - what is the letter for? (i.e., what medical/graduate school?...what scholarship?...what position in your squadron or group?...what career field in the Air Force?)
  - name/address for sending the reference letter
  - resumé of your relevant extracurricular activities (clubs, teams, volunteer activities), honors, awards, experience, previous leadership positions, etc.; explicitly indicate what each activity

involved, who the beneficiaries were (for volunteer activities), what your responsibilities were (for leadership positions), how large the squadron/element/flight/cadre was, etc.

- provide any standardized forms that should accompany the reference letter (or that alone comprise the reference document)...before giving this form to your reference, sign/date the signature block that indicates that you waive (or do *not* waive) your right to view the content of the letter

Follow up

- check with your reference a few days in advance of the deadline for receipt of the reference letter
- after the reference letter is submitted, appropriately thank the instructor for her/his efforts and time in supporting your application
- inform your reference of the ultimate outcome of your application

BIOLOGY MAJOR REQUIREMENTS WORKSHEET

Required Biology Courses

- ❑ Biology 330 (F,S) Zoology
- ❑ Biology 331 (F,S) Botany
- ❑ Biology 332 (F,S) Microbial Diversity
- ❑ Biology 360* (F,S) Cell and Molecular Biology
- ❑ Biology 363* (F,S) Genetics
- ❑ Biology 380 (F,S) Principles of Ecology
- ❑ Biology 480* (F,S) Biology Capstone Seminar
- ❑ Human Physiology Option (choose **1** of the following 3 Biology courses)**:**
  - ❑ Biology 345 (F) Aerospace Physiology
  - ❑ Biology 410 (F) Anatomy and Physiology: Sensory and Motor Integration
  - ❑ Biology 440 (S) Anatomy and Physiology: Visceral Systems Integration

Organic Chemistry – 1 course

- ❑ Chem 230 or 333 (F,S; F) Introductory Organic Chemistry **or** Organic Chemistry I

Biology Option – 3 courses, 300-/400-level Bio course; maximum 1 organic chemistry or biochemistry

- ❑ Biology 320* (S) Biomechanics
- ❑ Biology 345 (F) Aerospace Physiology
- ❑ Biology 370 (F) Human Nutrition
- ❑ Biology 410 (F) Anatomy and Physiology: Sensory and Motor Integration
- ❑ Biology 430* (F, odd# yrs) Vertebrate Zoology
- ❑ Biology 431* (S) Microbiology
- ❑ Biology 440 (S) Anatomy and Physiology: Visceral Systems Integration
- ❑ Biology 459* (S, odd# yrs) Principles of Evolution
- ❑ Biology 464* (F) Molecular Biology Methods
- ❑ Biology 481* (F) Applied Ecology
- ❑ Biology 486* (S) Principles of Chem, Biol, Radiol, and Nuc (CBRN) Warfare Defense
- ❑ Biology 495 (see list) Special Topics
- ❑ Chem 334 or 434 (S; S) Organic Chemistry II or Biochemistry

Scientific Breadth Option** – 2 non-core courses, 200-level or above (Biology, Chemistry, Computer Science, Physics, Mathematics); approved courses in other academic divisions**:**

- ❑ Beh Sci 320* (S) Lifespan Development
- ❑ Beh Sci 355* (F) Biopsychology
- ❑ Beh Sci 373* (S) Introduction to Human Factors
- ❑ Civ Engr 362* (F,S) Introduction to Environmental Engineering
- ❑ Civ Engr 368* (S) Ground and Surface Water Hydrology and Contaminant Transport
- ❑ Civ Engr 369* (F) Introduction to Air Pollution
- ❑ Civ Engr 463* (F) Wastewater Treatment Plant Design
- ❑ Civ Engr 467* (S) Water Treatment Principles and Design
- ❑ Geo 350 (S) Human Geography
- ❑ Geo 351 (F) Introduction to Physical Geography
- ❑ Geo 353 (S, odd# yrs) Geomorphology
- ❑ Geo 360 (S, even# yrs) Environmental Geography
- ❑ Geo 382* (S) Remote Sensing and Imagery Analysis
- ❑ History 482* (F) History of Science and Technology
- ❑ Law 371 (S) Environmental Law and Policy
- ❑ Philos 330* (S) Introduction to the Philosophy of Science
- ❑ Philos 410* (F) Medical Ethics

Academy Option – 1 3-hour course

- ❑ Any non-core course offered by DF (including Math 130 and English 110)

denotes course with prerequisite(s) other than Biology 210/215/315

****for foreign-language minor, may substitute 1-2 ≥200-level foreign-language courses with DFB approval.***